DNC 13(T)

Basic Radio Propagation Predictions

FOR SEPTEMBER 1952

Three Months in Advance

Issued June 1952

CRPL Series D Number 94

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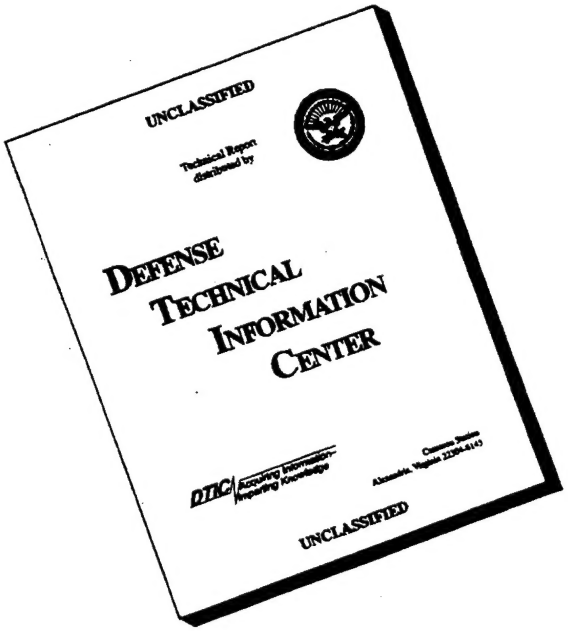

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Central Radio Propagation Laboratory

The propagation of radio waves over long distances depends on their reflection from the ionosphere, the electri- conducting layers in the earth's upper atmosphere. The characteristics of these layers are continually chang- For regular and reliable communication, it is therefore necessary to collect and analyze ionospheric data from ns all over the world in order that predictions of usable frequencies between any two places at any hour can be

During the war, the United States Joint Communications Board set up the Interservice Radio Propagation atory at the National Bureau of Standards to centralize ionospheric work and predictions for the Armed Forces e United States.

n May 1, 1946, this activity returned to peacetime status as the Central Radio Propagation Laboratory of the nal Bureau of Standards. Designed to act as a permanent centralizing agency for propagation predictions and s, analogous in the field of radio to the reports of the Weather Bureau in the field of meteorology, the Central Propagation Laboratory was established in cooperation with the many Government agencies vitally concerned communication and radio propagation problems. These agencies are represented on an Executive Council which s the work of the Laboratory; included are the Department of the Army, Department of the Navy, Department e Air Force, Civil Aeronautics Administration, Federal Communications Commission, Department of State, Guard, Coast and Geodetic Survey, and the Weather Bureau. In addition, industry is represented by a member Institute of Radio Engineers and a member of the Radio Manufacturers Association, while the Carnegie Insti- of Washington serves in an advisory capacity and the Research and Development Board has designated an ver.

he Central Radio Propagation Laboratory receives and analyzes data from approximately 60 stations located ghout the world, including 13 domestic and 8 overseas stations which are operated either directly or under act by the National Bureau of Standards. Ionospheric data and predictions are disseminated to the Armed s, commercial users, scientists, and laboratories. The basic ionospheric research of the Laboratory includes etical and experimental studies of maximum usable frequencies, ionospheric absorption, long-time variations of propagation characteristics, the effects of the sun on radio propagation, and the relation between radio dis- nce and geomagnetic variation. In the microwave field, the Laboratory is investigating the relation between propagation and weather phenomena, as well as methods by which predictions can be made and radio communi- s improved in this portion of the radio-frequency spectrum. Another phase of the Laboratory's work is the pment and maintenance of standards and methods of measurement of many basic electrical quantities through- he entire frequency spectrum.

ic Radio Propagation Predictions

he CRPL Series D, Basic Radio Propagation Predictions, is issued monthly as an aid in the determination of est sky-wave frequencies over any path at any time of day for average conditions for the month of prediction, nths in advance. Charts of extraordinary-wave critical frequency for the $F2$ layer, of maximum usable fre- ncy for a transmission distance of 4,000 km, and of percentage of time occurrence for transmission by sporadic excess of 15 Mc, for a distance of 2,000 km, are included.

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13 (T) NONREGISTERED

UNCLASSIFIED

DEPARTMENT OF THE NAVY
OFFICE OF THE CHIEF OF NAVAL OPERATIONS
Washington 25, D. C.

28 April 1952

LETTER OF PROMULGATION

NC 13 (T), BASIC RADIO PROPAGATION PREDICTIONS FOR SEPTEMBER 1952, is a nonregis- unclassified publication, issued to U.S. Naval Service predicting the useful frequencies for the month of mber 1952.

2. This publication is EFFECTIVE for use during the month of September 1952. It is distributed within the U.S. Navy through the facilities of the Registered Publication System in accordance with the allowances contained in the effective edition of the Registered Publication Allowance Tables.

3. This publication may be retained for reference purposes or destroyed after the period covered by the predictions is ended. No report of destruction is required.

W. B. AMMON
Rear Admiral, U.S. Navy
Director, Naval Communications

UNCLASSIFIED ORIGINAL

The printing of this publication has been approved by the Director of the Bureau of the Budget, May 23, 1949.

951783—Type B—52.

U. S. DEPARTMENT OF COMMERCE
Charles Sawyer, Secretary
NATIONAL BUREAU OF STANDARDS
A. V. Astin, Acting Director

JUNE 1952
CRPL Series D
Number 94

BASIC RADIO PROPAGATION PREDICTIONS

For SEPTEMBER 1952 — Three Months in Advance

Introduction

The CRPL-D series, "Basic Radio Propagation Predictions," issued by the National Bureau of Standards, contains contour charts of *F*2-zero-MUF and *F*2-4000-MUF for each of the three zones, W, I, and E, into which the world is divided for the purpose of taking into consideration the variation of the characteristics of the *F*2 layer with longitude (figs. 1 to 6); the world-wide contour chart of *E*-2000-MUF (fig. 7); the contour chart of median *fEs* (fig. 8); and the chart showing percentage of time occurrence for *Es*-2000-MUF in excess of 15 Mc (fig. 9).

Methods for using these charts are given in Circular 465 of the National Bureau of Standards, entitled "Instructions for the Use of Basic Radio Propagation Predictions," and available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., price 30 cents (foreign 40 cents). Requests for this manual and for the basic predictions from members of the Army, Navy, or Air Force should be sent to the proper service address as follows. *For the Army:* Office of the Chief Signal Officer, Department of the Army, Washington 25, D. C., Attention: SIGOL–2. *For the Navy:* Chief of Naval Operations, Department of the Navy, National Defense Building, Washington 25, D. C. (CNO OP–203Q). *For the Air Force:* Director of Communications, Department of the Air Force, Washington 25, D. C., Attention: AFOAP.

Following figure 9 of each issue, sets of auxiliary figures (nos. 1, 2, 11, 12, NBS Circular 465) or forms CRPL–AF and AH are given in rotation, two in each issue of CRPL Series D. They are necessary or useful for the preparation of tables and graphs of MUF and FOT (OWF), as explained in NBS Circular 465.

The charts in this issue were constructed from data through March 1952, together with a predicted smoothed 12-month running-average Zürich sunspot number of 46, centered on September 1952.

Attention is invited to the blank form at the end of this publication, for use in reporting the accuracy of the predictions of MUF and FOT (OWF) as given in this report. Communications should be addressed to Central Radio Propagation Laboratory, National Bureau of Standards, Washington 25, D. C.

Information concerning the theory of radio-wave propagation, measurement technics, structure of the ionosphere, ionospheric variations, prediction methods, absorption, field intensity, radio noise, lowest required radiated power and lowest useful high frequency is given in Circular 462 of the National Bureau of Standards, "Ionospheric Radio Propagation." This circular is available from the Superintendent of Documents, price $1.00 (foreign, $1.25).

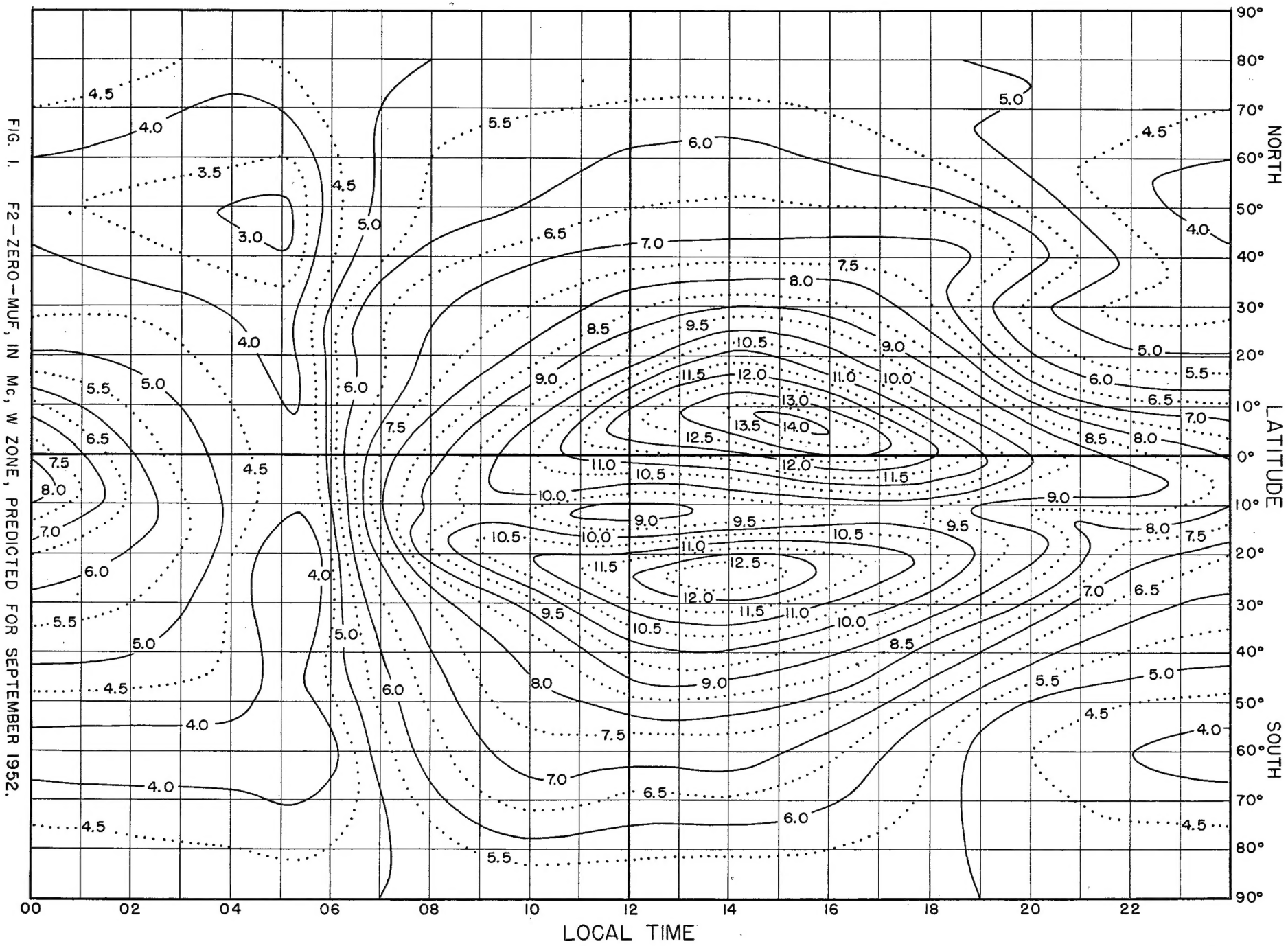

FIG. 1. F2-ZERO-MUF, IN Mc, W ZONE, PREDICTED FOR SEPTEMBER 1952.

NBS 469 LOCAL TIME - LATITUDE GRID DIV 14

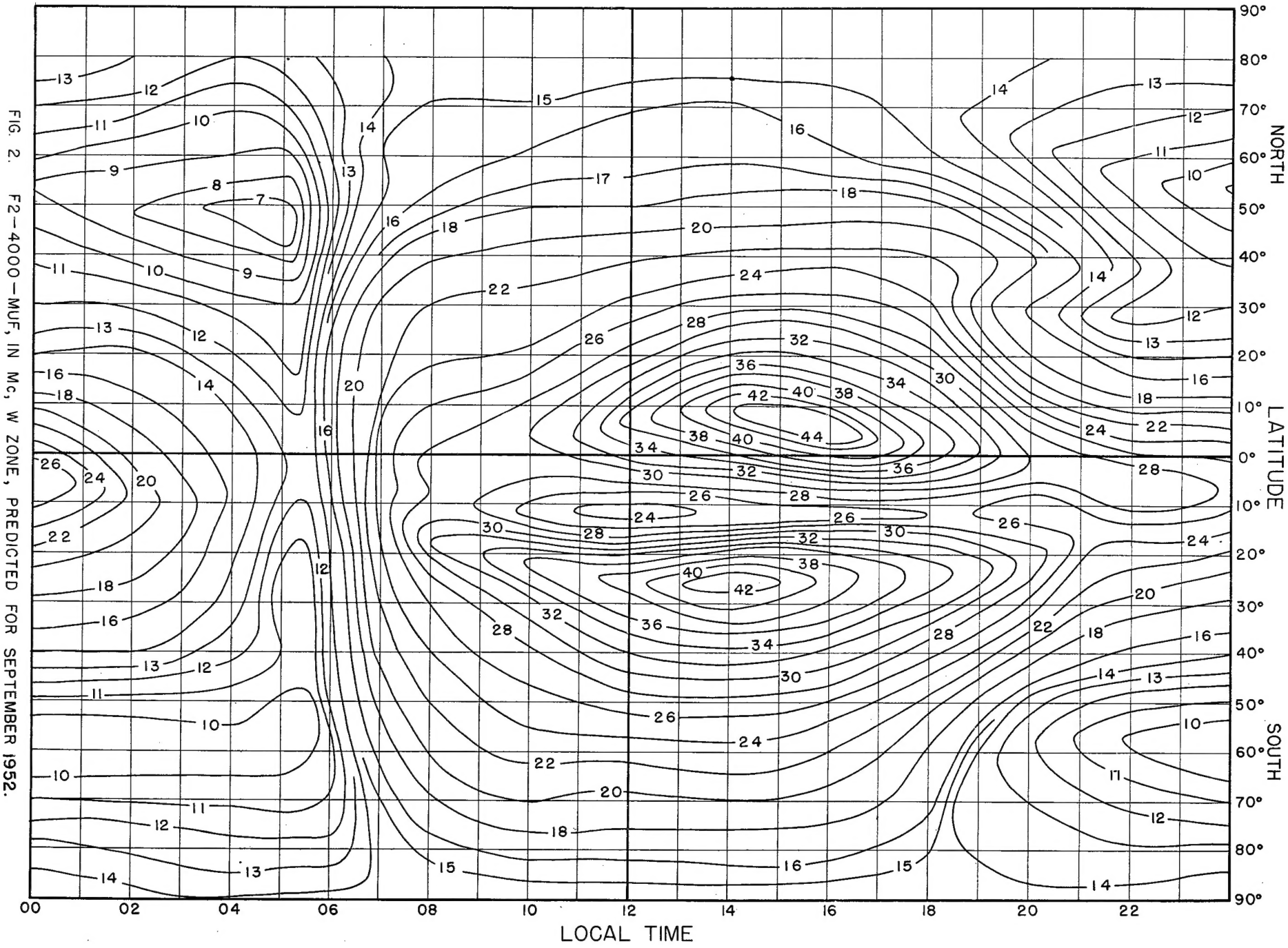

FIG. 2. F2–4000–MUF, IN Mc, W ZONE, PREDICTED FOR SEPTEMBER 1952.

NBS 489 LOCAL TIME – LATITUDE GRID DIV 14

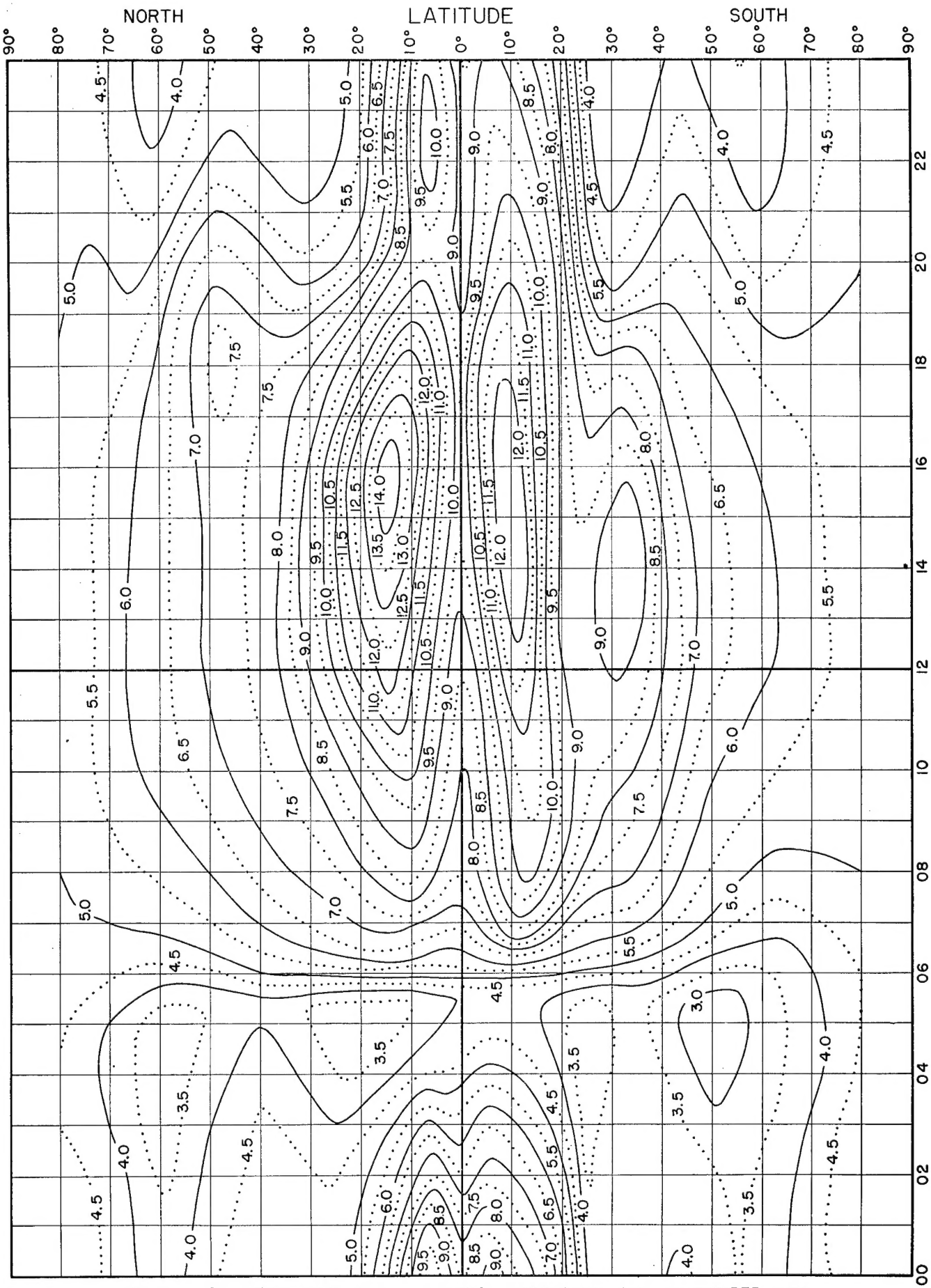

FIG. 3. F2–ZERO–MUF, IN Mc, I ZONE, PREDICTED FOR SEPTEMBER 1952.

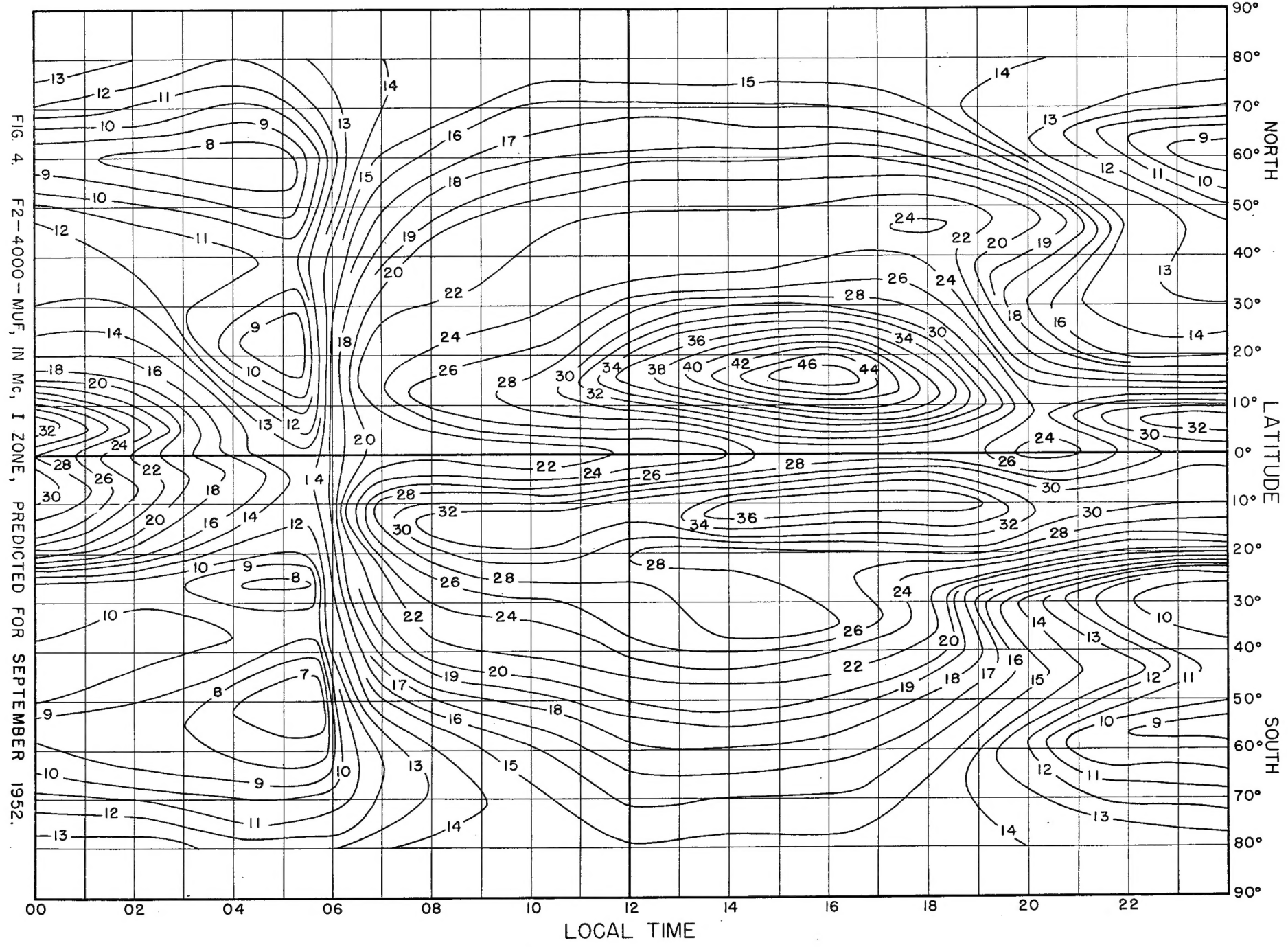

FIG. 4. F2–4000–MUF, IN Mc, I ZONE, PREDICTED FOR SEPTEMBER 1952.

NBS 469 LOCAL TIME – LATITUDE GRID DIV 14

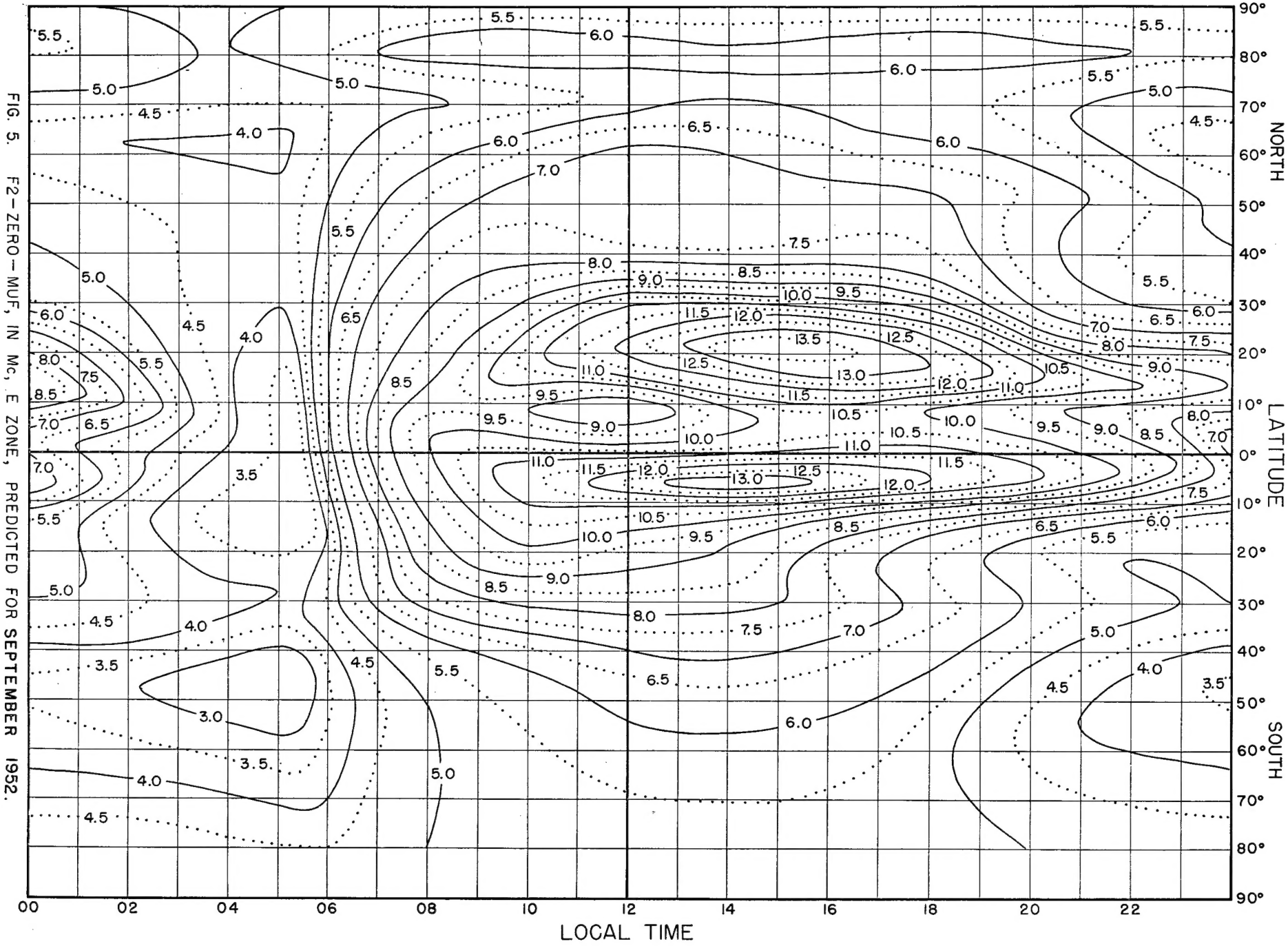

FIG. 5. F2-ZERO-MUF, IN Mc, E ZONE, PREDICTED FOR SEPTEMBER 1952.

NBS 489 LOCAL TIME - LATITUDE GRID DIV 14

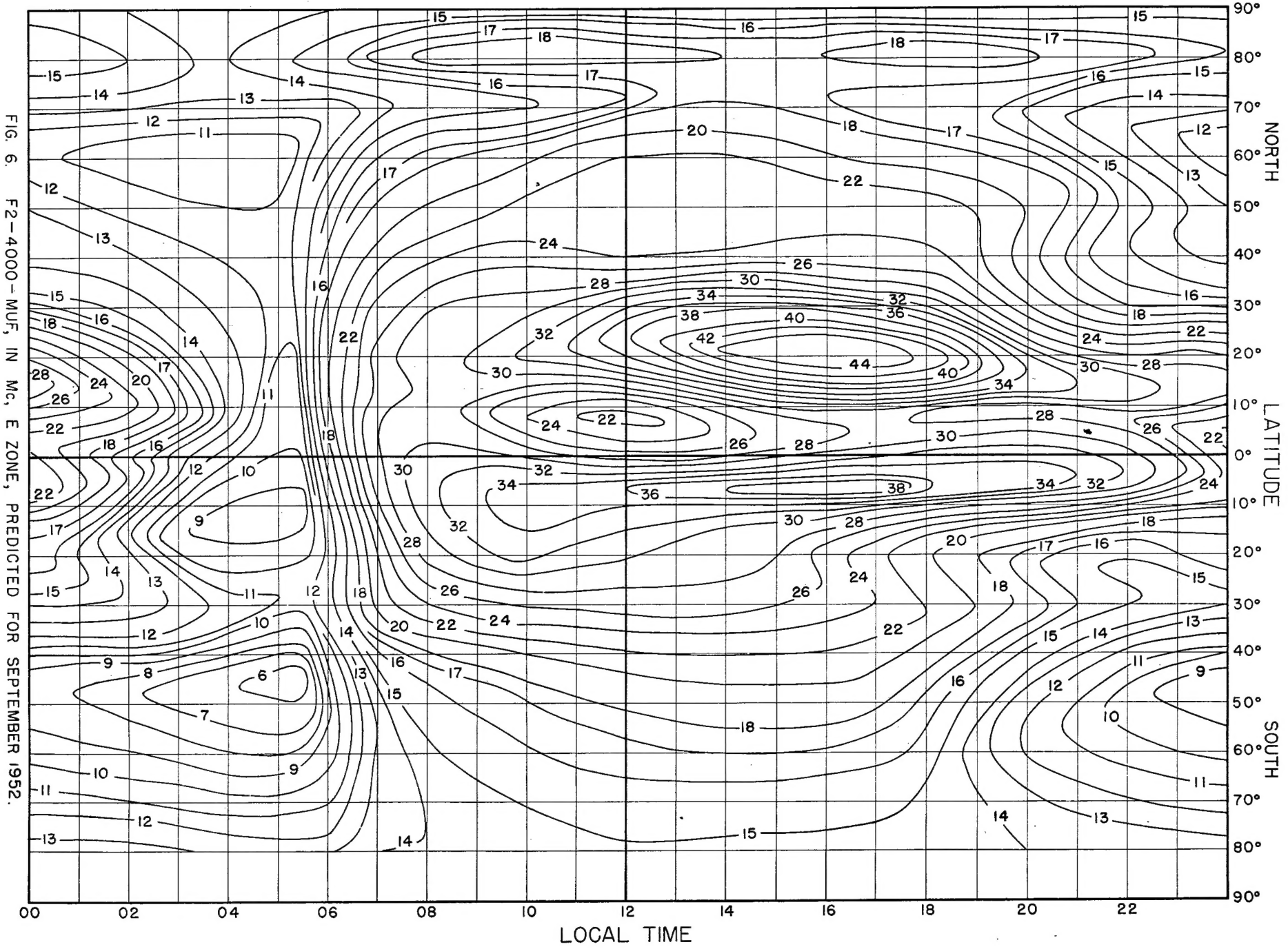

FIG. 6. F2-4000-MUF, IN Mc, E ZONE, PREDICTED FOR SEPTEMBER 1952.

NBS 489 LOCAL TIME - LATITUDE GRID DIV 14

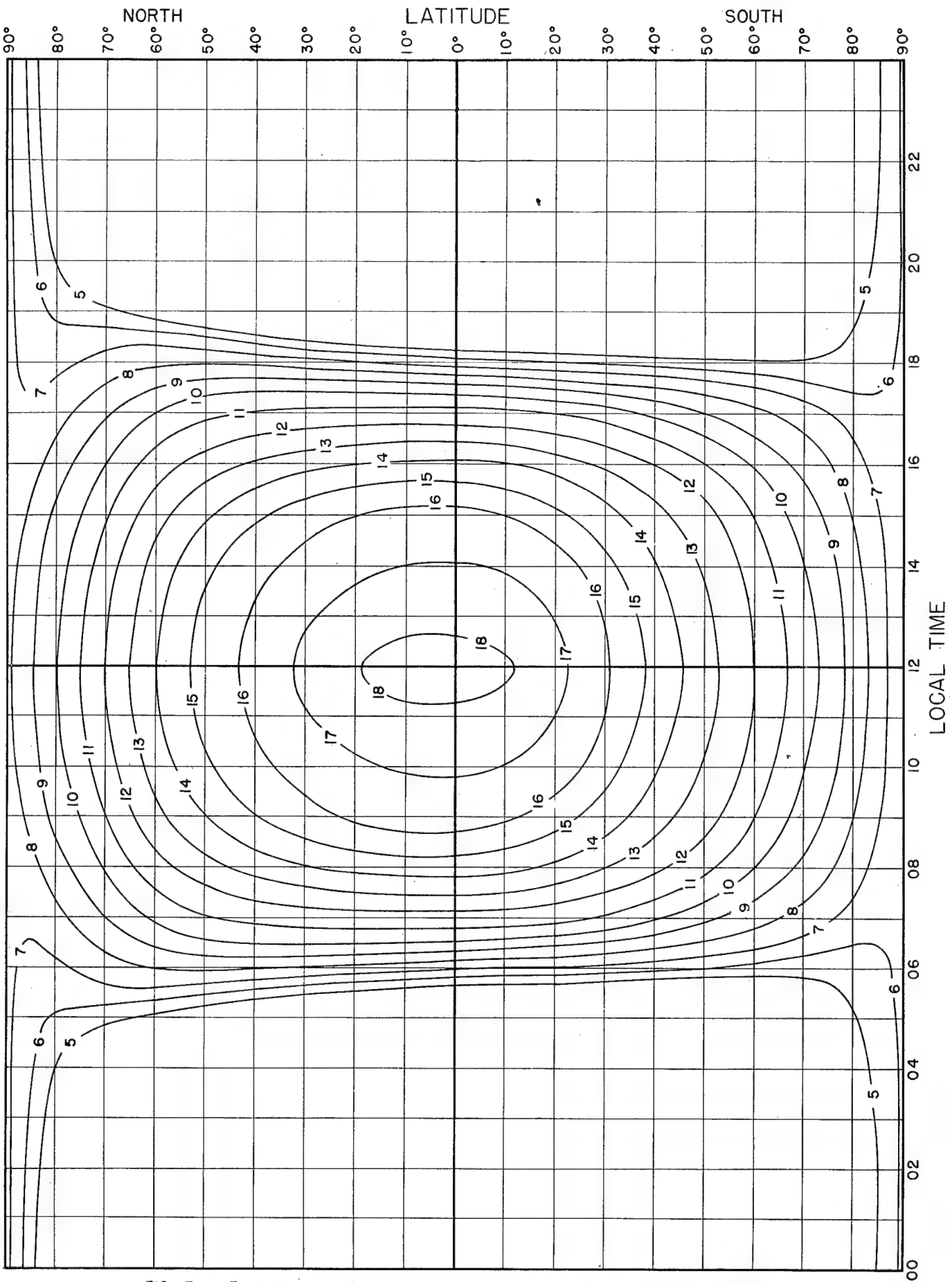

FIG. 7. E – 2000 – MUF, IN Mc, PREDICTED FOR SEPTEMBER 1952.

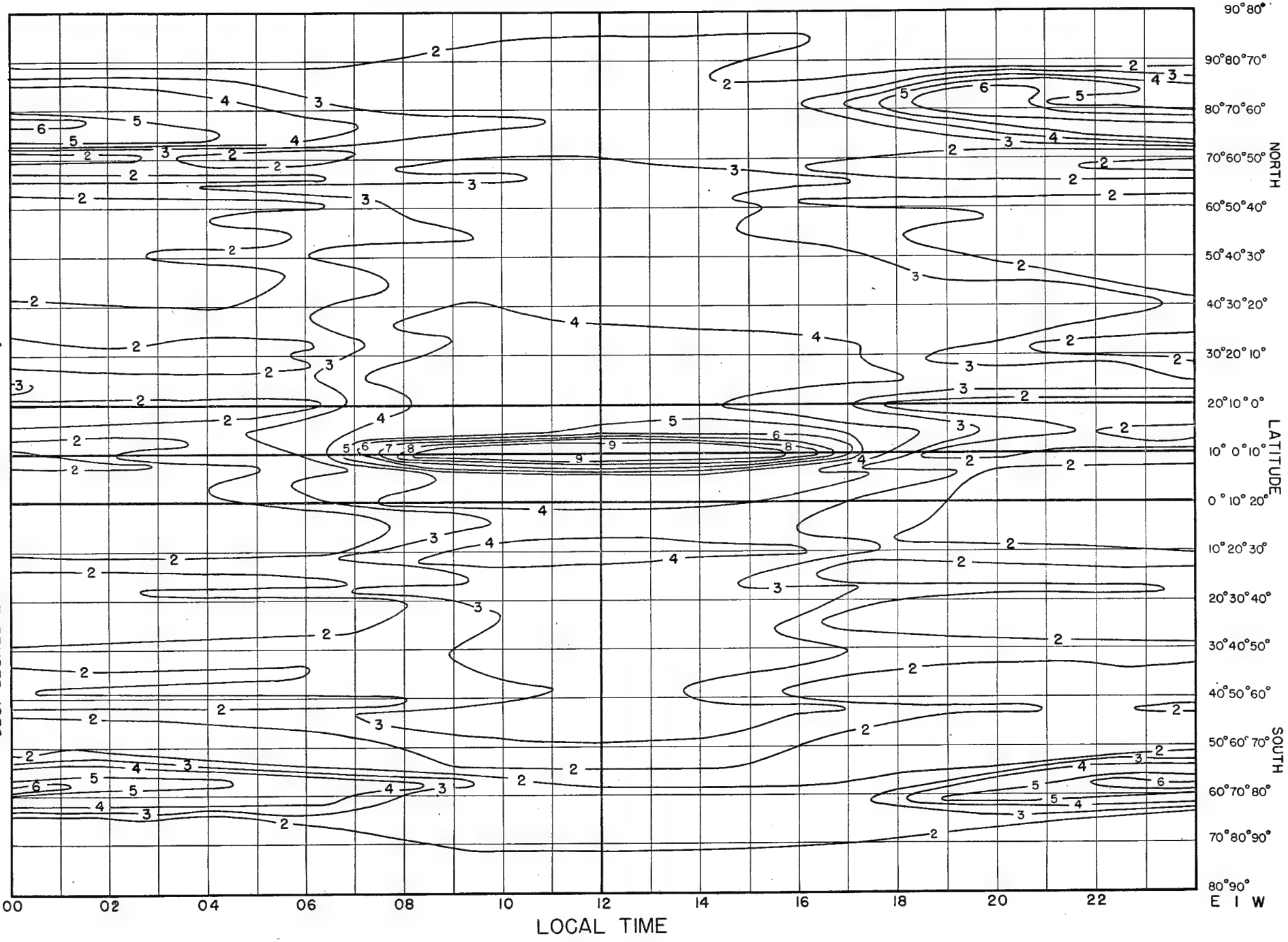

FIG. 8. MEDIAN f_{Es}, IN Mc, PREDICTED FOR SEPTEMBER 1952.

NBS 469 LOCAL TIME – LATITUDE GRID DIV 14

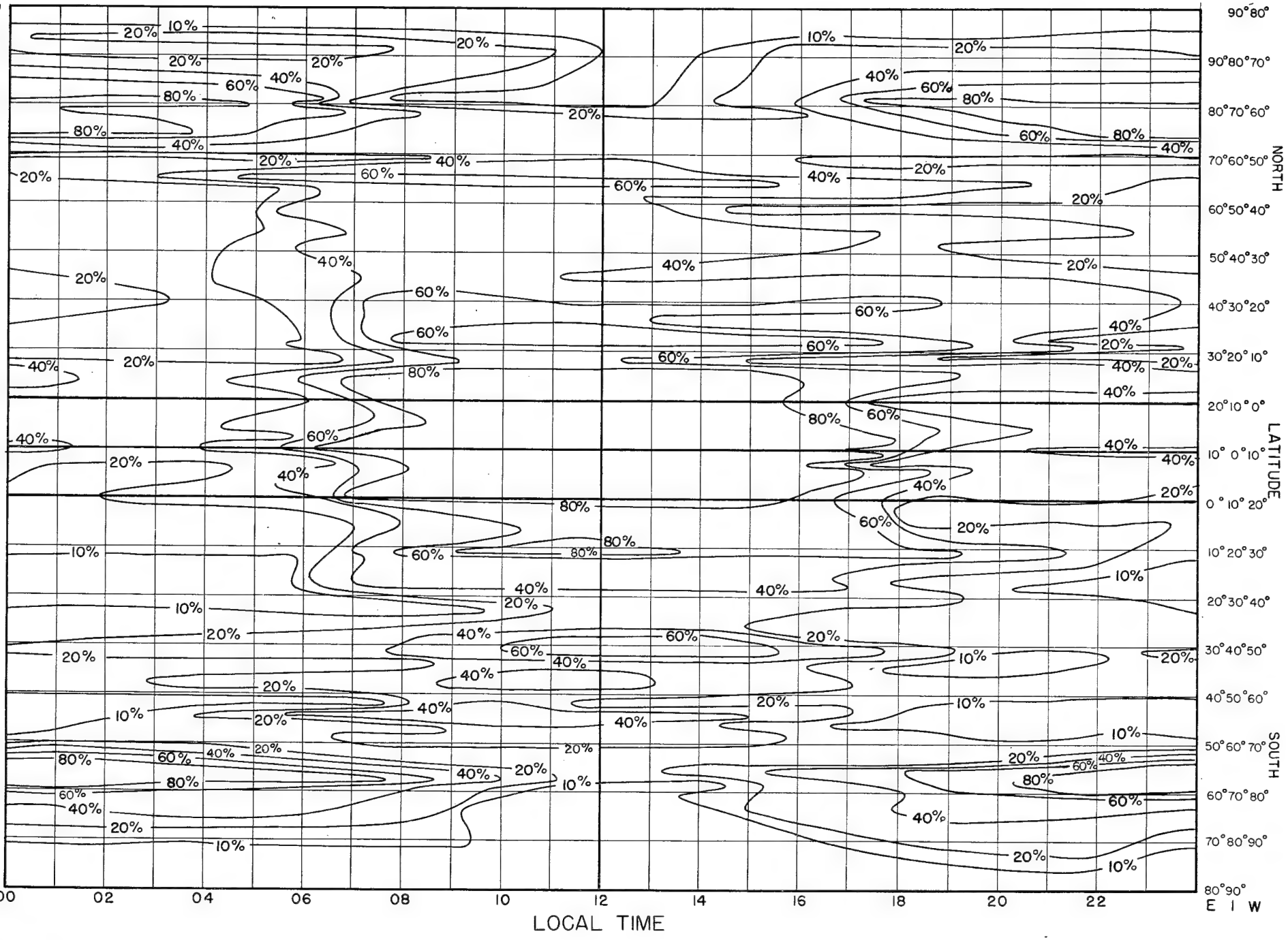

FIG. 9. PERCENTAGE OF TIME OCCURRENCE FOR Es–2000-MUF IN EXCESS OF 15 Mc, PREDICTED FOR SEPTEMBER 1952.

CRPL

FORM AF

Date _____

MUF – FOT WORK SHEET FOR PATHS 4000 KM OR LESS

From _____ To _____ Distance, _____ km Zone ____ Predicted for ____ 19__

Note: All frequencies are in megacycles.

GCT	fEs	Es 2000-muf	E-layer 2000-muf	F2 zero-muf	F2 4000-muf	Es-muf for Path	E-F1-muf for Path	F2-muf for Path	Es 2000-fot	Es-fot for Path	E-fot for Path	F2-fot for Path	MUF for Path	FOT for Path
	a	b	c	d	e	f	g	h	i	j	k	l	m	n
Procedure	Scale	5 X a	Scale	Scale	Scale				b-4.0		Same as g	.85 h	Highest of f, g, h	Highest of j, k, l
00														
01														
02														
03														
04														
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23														
Done by														
Checked														

NOTE: FOT IS THE SYMBOL FOR OPTIMUM TRAFFIC FREQUENCY (FORMERLY OWF).

FORM AH

CRPL

Date _____

MUF-FOT WORK SHEET FOR PATHS OVER 4000 KM.

From _____ To _____ Distance, _____ km Predicted for _____ 19___

Note: All frequencies are in megocycles.

	A-end						B-end											
	Pt. A in ____ Zone			Pt. A' in ____ Zone			Pt. B in ____ Zone			Pt. B' in ____ Zone			MUF	MUF	FOT	FOT	MUF	FOT
GCT	fEs	Es 2000-muf	F2 4000-muf	E-layer 2000-muf	Es 2000-fot	F2 4000-fot	fEs	Es 2000-muf	F2 4000-muf	E-layer 2000-muf	Es 2000-fot	F2 4000-fot	A-end	B-end	A-end	B-end	for PATH	for PATH
	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r
Procedure	Scale pt. A'	5 X a	Scale pt. A	Scale pt. A'	b-4.0	.85 c	Scale pt. B'	5 X g	Scale pt. B	Scale pt. B'	h-4.0	.85 i	Highest of b,c,d	Highest of h,i,j	Highest of d,e,f	Highest of j,k,l	Lower of m,n	Lower of o,p
00																		
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NOTE: FOT IS THE SYMBOL FOR OPTIMUM TRAFFIC FREQUENCY (FORMERLY OWF)

(Cut along this line)

Form for Report to CRPL on Accuracy of Predictions

Name _____ Date _____

Address _____ _____ _____ _____ _____ _____
No. Street City P.O. Zone State Country

From (between) _____ to (and) _____ Date _____

Time (specify zone)																
Frequency Used																
D-Series Predicted FOT (OWF) Regular Layers																
D-Series Predicted FOT (OWF) Including Es																

Further comment (including notes on quality of communication):

CRPL and IRPL Reports

[A list of CRPL Section Reports is available from the Central Radio Propagation Laboratory upon request]

Daily:

Radio disturbance warnings, every half hour from broadcast station WWV of the National Bureau of Standards. Telephoned and telegraphed reports of ionospheric, solar, geomagnetic, and radio propagation data.

Weekly:

CRPL—J. Radio Propagation Forecast (of days most likely to be disturbed during following month).

Semimonthly:

CRPL—Ja. Semimonthly Frequency Revision Factors For CRPL Basic Radio Propagation Prediction Reports.

Monthly:

CRPL—D. Basic Radio Propagation Predictions—Three months in advance. (Dept. of the Army, TB 11–499–, monthly supplements to TM 11–499; Dept. of the Navy, DNC 13 ( ) series; Dept. of the Air Force, TO 16-1B-2 series.)
CRPL—F. Ionospheric Data.
*IRPL—A. Recommended Frequency Bands for Ships and Aircraft in the Atlantic and Pacific.
*IRPL—H. Frequency Guide for Operating Personnel.

Circulars of the National Bureau of Standards:

NBS Circular 462. Ionospheric Radio Propagation.
NBS Circular 465. Instructions for the Use of Basic Radio Propagation Predictions.

Reports issued in past:

IRPL—C61. Report of the International Radio Propagation Conference, 17 April to 5 May 1944.
IRPL—G1 through G12. Correlation of D. F. Errors With Ionospheric Conditions.
IRPL—R. Nonscheduled reports:
R4. Methods Used by IRPL for the Prediction of Ionosphere Characteristics and Maximum Usable Frequencies.
R5. Criteria for Ionospheric Storminess.
**R6. Experimental Studies of Ionospheric Propagation as Applied to the Loran System.
R7. Second Report on Experimental Studies of Ionospheric Propagation as Applied to the Loran System.
R9. An Automatic Instantaneous Indicator of Skip Distance and MUF.
R10. A Proposal for the Use of Rockets for the Study of the Ionosphere.
**R11. A Nomographic Method for both Prediction and Observation Correlation of Ionosphere Characteristics.
**R12. Short Time Variations in Ionosphere Characteristics.
R14. A Graphical Method for Calculating Ground Reflection Coefficients.
**R15. Predicted Limits for F2-Layer Radio Transmission Throughout the Solar Cycle.
**R17. Japanese Ionospheric Data—1943.
R18. Comparison of Geomagnetic Records and North Atlantic Radio Propagation Quality Figures—October 1943 Through May 1945.
**R21. Notes on the Preparation of Skip-Distance and MUF Charts for Use by Direction-Finder Stations. (For distances out to 4000 km.)
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**R24. Relations Between Band Width, Pulse Shape and Usefulness of Pulses in the Loran System.
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**R26. The Ionosphere as a Measure of Solar Activity.
R27. Relationships Between Radio Propagation Disturbance and Central Meridian Passage of Sunspots Grouped by Distance From Center of Disc.
**R30. Disturbance Rating in Values of IRPL Quality-Figure Scale from A. T. & T. Co. Transmission Disturbance Reports to Replace T. D. Figures as Reported.
**R31. North Atlantic Radio Propagation Disturbances, October 1943 Through October 1945.
**R33. Ionospheric Data on File at IRPL.
**R34. The Interpretation of Recorded Values of *fEs*.
**R35. Comparison of Percentage of Total Time of Second-Multiple *Es* Reflections and That of *fEs* in Excess of 3 Mc.
IRPL—T. Reports on tropospheric propagation:
T1. Radar operation and weather. (Superseded by JANP 101.)
T2. Radar coverage and weather. (Superseded by JANP 102.)
CRPL—T3. Tropospheric Propagation and Radio-Meteorology. (Reissue of Columbia Wave Propagation Group WPG—5.)

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